

A section is devoted to the insects which prey upon plants, and to the measures to be taken for the destruction of these pests, as well as of fungi. That the book is up to date may be gathered by the references to Mendelism and De Vries.

A copious index is given, as well as hints as to the way in which examination questions should be answered.

A little more information as to the "reason why" of digging, watering, striking cuttings, and other garden operations would have increased the value of the book, which nevertheless is one which can confidently be recommended to the attention of all those interested in gardening.

Dr. Schlich's Manual of Forestry. Vol. iv. Forest Production. By W. R. Fisher. Being an English adaptation of "Der Forstschutz," by Dr. Richard Hess. Second edition. Pp. xxiii+712. (London: Bradbury, Agnew and Co., Ltd.)

This volume is the second edition of Prof. Fisher's "Forest Protection," and is uniform with the third edition of vols. i., ii., and iii. of Dr. Schlich's "Manual of Forestry." The book is an English adaptation of Dr. Hess's "Forstschutz," that is, it is not a mere translation, as the author has exercised discretion in his selection of material in order to make the book more adapted to the use of British and Indian foresters. New illustrations have also been added which are not in the German edition. The subject of forest protection is of immense importance, and covers a wide field of knowledge, practically including every branch of scientific silviculture. The author has arranged and presented the various protective measures to be adopted against inimical agencies, both in the organic and inorganic worlds, in a very clear and interesting manner. The volume also contains a useful index at the end. Prof. Fisher has done valuable work by rendering available to student and forester a vast store of information which has hitherto been accessible only to a few. The book is one which we can warmly recommend to all those who have forests or trees under their charge.

The Essentials of Histology, Descriptive and Practical. By Prof. E. A. Schäfer, F.R.S. Seventh edition. Pp. xi+507. (London: Longmans, Green and Co., 1907.) Price 10s. 6d. net.

THE fact that this volume has reached its seventh edition shows conclusively that it supplies a want. The features of the present edition are the introduction of colouring in the illustrations and a considerable increase in the part devoted to the nervous system. In this portion practically a new set of illustrations appears, which can only be described as admirably calculated to indicate the salient points which the elementary student must be familiar with. Either for the purely scientific or for the medical student this book will continue to be of the highest value.

Actualités scientifiques. By Max de Nansouty. Pp. 361. (Paris: Schleicher Frères, 1906.) Price 3.50 francs.

THE general character of this annual publication was described in noticing the issue for 1905 in NATURE of November 23, 1905 (vol. lxxiii., p. 76). The short essays on scientific subjects of current interest range over most branches of science, and should be useful as reading exercises in French classes in schools where the pupils also learn something of science.

LETTERS TO THE EDITOR.

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A Hydraulic Analogy of Radiating Bodies for Illustrating the Luminosity of the Welsbach Mantle.

THE device about to be described enables us to illustrate to a class the behaviour of different types of radiating bodies when introduced into a flame, and will be found especially useful in explaining the remarkable luminosity of the incandescent mantles used in modern gas-lighting. It is, of course, not intended to explain the mechanics of radiation, but merely to enable us to describe certain phenomena in terms of easily grasped notions.

Students are told that the more powerfully a body absorbs the more powerfully will it emit when heated, this relation holding for every individual wave-length. Black bodies, then, give out the most light when heated. The fact that a white block of lime is far more luminous than a carbon rod when heated in the oxyhydrogen flame is not usually cited in support of this law, while the fact that the most luminous body of all, the Welsbach mantle, is also quite white, is equally unsatisfactory as an illustration, for white bodies are in reality transparent, that is, they are made up of masses of small transparent particles, and transparent bodies ought not to emit at all. It is, of course, necessary to define just what we mean by transparency in this case, and it may be well to consider first a somewhat analogous case. The absorption which is accompanied by high emissivity is true absorption, and not selective reflection, which is sometimes confused with absorption. A highly reflecting polished metal surface is a poor radiator, but by properly constructing its surface we may give it the power to absorb and emit. A bundle of polished steel needles with their points all turned towards the source of light reflects scarcely any light at all, the rays undergoing multiple reflections between the conical ends of the needles. Such a bundle of needles should emit much more powerfully than a polished steel surface, and it is easy to see just why it should do so. Each needle, seen end on, sends not only emitted light to the eye, but reflects rays coming from its neighbours. The surface formed by the points of the needles can be regarded as an absorbing surface, which absorbs in virtue of its structure; it is analogous to the hollow "black bodies" with which we are now familiar. The point which I wish to emphasise is that such a surface, which absorbs not at all in virtue of its molecular nature, is also a powerful radiator, the mechanism by which its radiating power has been increased being as indicated above.

Suppose, now, we take a perfectly transparent body, which, like a perfect reflector, has no emitting power. A bead of microcosmic salt (sodium pyro-phosphate) heated in a blast lamp is a good example. Though the platinum wire which supports it glows with vivid incandescence, the bead remains perfectly dark. A glass bead, however, emits a good deal of light, doubtless from the fact that its transparency is much less at high temperatures, a very common behaviour of transparent substances. The microcosmic salt on cooling becomes traversed by hundreds of cleavage planes, which give it a milky appearance. On re-heating it it emits light strongly, until it finally fuses into a transparent drop, when it instantly becomes dark again. The reason for this behaviour is not quite so apparent as in the case of the needles. In fact, I am not quite sure that I understand it at all. Quartz behaves in the same way. A drop of clear fused quartz, heated in the blast, emits little or no light, but if it contains spots made up of an emulsion of quartz and air, these spots emit strongly. In other words, an opacity resulting from a pulverisation of the transparent medium seems to be accompanied with a strong emitting power. Apparently we cannot apply the same reasoning as in the case of the needles, and it looks rather as if the radiation was largely a surface effect. If this is so, it is obvious that an

increase of the surface, by enclosures of air, will increase the radiating power. It is my intention to make some measurements of the intensity of the light radiated from the ends of long and short cylinders of red-hot glass.

The hydraulic analogy of radiating bodies which we will now consider occurred to me during a lecture on radiation, and proved quite useful in explaining the different behaviour of various types of radiators.

The radiator is represented by a tall hollow cylinder, open at the top and closed at the bottom, provided with a number of outflow pipes of different sizes as shown in

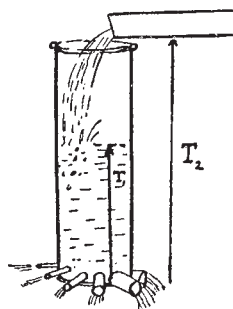


FIG. 1.

Fig. 1. Water flows into the cylinder at a certain definite rate from a horizontal pipe or flume, the height of which above the base of the cylinder (T_2) represents the temperature of the flame. Obviously the level of the water in the cylinder will rise until the rate at which the water flows out exactly equals the rate at which it flows in. This height (T_1) is the temperature which the radiator acquires in the flame. The jets of water which issue from the tubes represent radiation of different wave-lengths, the small jets representing the short waves.

We will first suppose our hydraulic radiator to represent

a black body, say a lump of carbon. In this case all the pipes at the bottom are wide open, and we have the maximum outflow of all wave-lengths for any given temperature, *i.e.* for any given height of the fluid within the cylinder. If we take the cylinder empty and plunge it into water, jets will squirt into it through the pipes, that is, it is a perfect absorber for all wave-lengths. With all the pipes open, however, the level of the water within the cylinder will not rise to any great height, owing to the limited rate at which water flows in from the horizontal pipe. This means that the lump of carbon in the flame does not rise to a very high temperature because it radiates energy at a high rate. At the low temperature there is comparatively little visible light in the radiation, for the shorter waves only appear in quantity at high temperatures. We can imitate this condition in our hydraulic model if we choose by putting valves on the inside of the tubes, those on the small tubes opening only at high pressures.

To make our model imitate the bead of microcosmic salt we plug up all the pipes. The cylinder now represents a transparent body. If immersed in water it absorbs nothing through the pipes, and no matter how high the level of the water rises in it there is no emission of fluid, in other words, no radiation. The body rises in temperature until the temperature is equal to that of the flame, but there is no radiation. Take next the case of the lime in the oxyhydrogen flame. It is a partially transparent substance, and we can imitate it by plugging the tubes with glass beads or cotton. Owing to the lesser rate at which the water now flows out through the tubes, the level rises much higher than when the tubes are all open, and owing to the greater pressure (temperature) we have liquid jets through the small tubes (short wave-length radiation). The inferiority in the emissivity is more than made up for by the higher temperature which the body can acquire. We are now ready for the Welsbach mantle.

It has been conclusively shown by Rubens that the peculiar brilliancy of the thorium mantles, caused by a small trace of cerium, is due to the fact that the cerium makes the thorium selectively absorbing for the short waves at high temperatures. If we wave a Bunsen flame over a mantle in a brilliantly lighted room, it will be seen to turn yellow at a temperature a little below a red heat. In other words, it becomes a strong absorber for the short waves. It is, however, transparent for the long waves, consequently it does not emit energy at anything like the rate at which a black body does, and in consequence can rise to a high temperature in the flame, exactly as a pure

thorium mantle. Its band of absorption in the blue region enables it to pour out visible radiations nearly as powerfully as those which a black body at the same temperature would emit, hence its enormous brilliancy. Our hydraulic model, with its tubes all plugged with cotton, represents the mantle of pure thorium, while to transform it into the Welsbach mantle we have only to pull out the porous plugs from some of the smaller tubes. In this condition, owing to the impeded flow in the large tubes, the water will rise in the cylinder to a great height, and we get very powerful jets from the small tubes which we have opened, much more powerful than in either of the previous cases considered. Of course, with all the tubes open we could get equally intense small jets if we poured the water in at the top at a sufficient rate. There is a limit to this rate, however, for it is obvious that the rate at which the water is poured in at the top corresponds to the rate at which the flame can pour energy into the radiating body, a circumstance which depends on the conductivity of the body for heat and other things.

It is not necessary to make the hydraulic apparatus, of course, for its action is so easily understood that a diagram answers every purpose. Its utility lies in the fact that it fixes in the mind of the student the behaviour of different types of radiators when plunged into a flame.

It could be made, perhaps, to illustrate the displacement of the point of maximum energy in the spectrum which accompanies a rise in temperature, but it is doubtful whether any such complications would prove beneficial. It seems best, on the whole, not to try to illustrate too much with it, as its relation to a radiating body is at best rather far-fetched.

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Retardation of Electroscopic Leak by means of recognised Radio-active Substances.

IN a communication made to the Royal Society on April 5, 1906, and subsequently published in the "Archives of the Middlesex Hospital," vol. vii., I described certain experiments which I regarded as showing that substances exist which retard the leak of an earthed metal electro-scope. I further asserted that an aluminium plate which had been kept in proximity to, but not in contact with, uranium, thorium, or pitchblende, also retards the electro-scope leak. This retardation does not necessarily occur immediately after introduction of the modified aluminium plate into the electro-scope, for after proximity to thorium there is a period, lasting three or four days, during which the leak is accelerated, and after proximity to radium I failed to find any evidence of retardation whatever. My results were received with scepticism, except by Sir William Ramsay, who had independently observed the same phenomenon in his laboratory. It is impossible to occupy your space with details, but it may be stated that gold-leaf electroscopes made of $\frac{1}{8}$ -inch lead were used, that the earthing of electroscopes and aluminium was complete, that effects of induction and alteration of capacity of the electro-scope were eliminated, and that the general conditions were kept as constant as possible.

Since reading the paper I have repeated the experiments in the most stringent way of which I am capable in a pathological laboratory, and have obtained identical results. Further, using the same apparatus, I have exposed the aluminium plates to X-rays for a period of three hours, and have found a complete absence of any change in the rate of leak, whether in the direction of retardation or of acceleration. Full details of these experiments will be published in the forthcoming number of the Archives of the Middlesex Hospital. Below I give the salient points of an experiment which was carried on continuously from August 10 to December 24, with the exception of intervals August 27 to September 11, and September 19-30, during both of which the electroscopes were left undisturbed. The values given represent percentages of the mean leak of the electro-scope during twenty-four hours under normal conditions corrected by the leak of the control electro-scope on the day for which the observation is given.

Lowest corrected percentage during period August 10 to